

# Socioeconomic status is a risk factor for allergy in parents but not in their children

R. L. BERGMANN, G. EDENHARTER, K. E. BERGMANN\*, S. LAU, U. WAHN and THE MULTICENTER ALLERGY STUDY RESEARCH GROUP

*Paediatric Pneumology and Immunology, and Department of Dermatology, Charité-Virchow Hospitals, Humboldt-University Berlin, \*Robert Koch Institut, Berlin, Germany*

## Summary

**Background** Allergic diseases are more prevalent in affluent countries, which has been attributed to life-style factors. Life-style habits may also differ between socioeconomic (SES) classes. The objective of this paper therefore was to evaluate if SES had an impact on the development of atopic disorders.

**Methods** A total of 1314 German children were followed-up in an observational birth cohort study to 6 years of age. Parents filled in questionnaires, and had multi-allergen screening tests for sensitization. Indoor allergen concentrations were determined by ELISA. Children were examined regularly up to 6 years, specific serum IgE values were determined by CAP-Rast-Feia.

**Results** The risk of aeroallergen sensitization (odds ratio 1.76; 95% CI 1.30–2.37), and the lifetime prevalence of hay fever (2.36; 1.76–3.17), and asthma (1.74; 1.08–2.80), but not of atopic dermatitis (AD: 0.90; 0.54–1.51) was elevated in parents of high compared to low SES. With high SES the risk of smoking in pregnancy (0.35; 0.23–0.51), in the home (0.31; 0.21–0.46), pet ownership (0.37; 0.26–0.55), high mite (0.42; 0.25–0.74), and high cat (0.38; 0.18–0.82) allergen concentration in house dust was reduced, but elevated for breastfeeding over more than 6 months (4.67; 2.9–7.48). In children, even after controlling for other risk factors, only the risk of AD from 3 to 6 years (2.42; 1.42–4.14) was elevated in families with high SES, but not of AD in infancy or of any other atopic disorder.

**Conclusions** While parents of high SES have a higher prevalence of inhalative allergies, their favourable life-style prevents the development of atopic disorders in their children, except for AD beyond infancy.

**Keywords:** Atopic diseases, parents, children, socioeconomic status, life-style

*Clinical and Experimental Allergy*, Vol. 30, pp. 1740–1745. Submitted 17 August 1999; revised 2 February 2000; accepted 25 March 2000.

## Introduction

Allergic diseases are generally more prevalent in affluent countries, which has been attributed to life-style factors [1,2]. But even within these countries, substantial differences in prevalence might exist between social groups [3]. Socioeconomic status (SES) and related indicators have been shown to be risk factors for atopic diseases.

From observations in two British national birth cohorts it was concluded that a higher social index was associated with reported AD at one, up to five years and at 16 years of age [4,5], and also with examined atopic eczema at 7, 11, and 16 years of age [6]. Reported hay fever at 11, 16 and 23 years was definitely associated with high social class [4,7]. In these cohorts, the number of older siblings, a component of SES, was shown to be inversely associated with the prevalence of reported hay fever [4,7]. But a study in London raised the suspicion that *adults* from higher social classes were more likely to be labelled as having hay fever [8]. It could be shown that an objective atopy marker such as

Correspondence: R. L. Bergmann, Paediatric Pneumology and Immunology, Charité-Virchow Hospitals of the Humboldt University Berlin, Augustenburger Platz 1, 13353 Berlin, Germany

a positive skin prick test in adults of the 1958 birth cohort was directly associated with a higher SES in childhood and inversely with the number of older siblings [9]. Similar results were obtained in several other studies [3,10,11]. These epidemiological findings support the hypothesis that a higher prevalence of early infections, being more common with lower SES, could protect against the development of allergic disorders [12].

On the other hand, viral infections in early life are positively associated with concomitant wheezing [13]. Other risk factors for infant or childhood wheezing, like prematurity, young maternal age, smoking, short breast feeding duration, and a high indoor allergen exposure are more common with low SES [14,15,16]. Asthma severity was higher in children of low SES families [17], but the persistence of symptoms to adolescence was more common with high SES [16].

It is obvious that socioeconomic status cannot be considered as a cause on its own right but rather as an indicator for environmental influences which may reduce or increase the risk of an atopic disorder. Our objective therefore is to evaluate in a prospective observational birth cohort study the influence of SES on the atopic phenotypes of parents, on the association between SES and atopy relevant life-style factors in families, and on the possible impact of these factors for the development of atopic disorders in children.

## Methods

### Subjects

For a prospective cohort study, 1314 infants were recruited out of 7609 newborns in six obstetric Departments of five German cities through the year 1990. Of the cohort 499 (38%) belonged to a 'high risk' group with at least two atopic family members and/or a cord blood IgE value above 0.9 kU/L; the 'control group' comprised 815 infants (62%), who had been chosen at random after the high risk group had been removed. Further details of the study design have been described in an earlier publication [18,19]. Parents gave their informed consent. The study was approved by the ethics committee of the university.

### Study design

In the delivery ward both parents filled in a self-administered questionnaire comprising the diagnoses and symptoms of atopic diseases they had or ever had had [18–19], and 18 months later on items describing SES. For follow-up, parents were interviewed and the infants examined in a standardized manner in paediatric clinics of each of the five cities (= study centres) at the ages 1, 3, 6, 12, 24, 36, 48, 60,

and 72 months. The continuous participation rate in the cohort decreased from 1128 (97%) at age 4 weeks to 880 (75%) at age 6 years, more rapidly so with lower SES (62%, 77%, 80% participation rate in the low, middle or high SES class, respectively), and slightly more in families without atopic history (no difference at 1, 3, 6, months, and at 6 years, but  $P \leq 0.001$  at other visits).

Blood samples were taken at 12, 24, 36 and at 60 months of age. Not all parents agreed to blood sampling; the prevalence of sampling participation was slightly but significantly higher in children from atopic compared to those from non atopic families. Specific IgE against four common food allergens and five aeroallergens were determined by the Pharmacia CAP assay [18]. Aeroallergen sensitization was assayed in blood samples of parents by the Phadiatop test (Pharmacia Germany). Parents with atopic history were as likely as those without to have a blood sample taken.

The concentration of mite and cat allergens in dust samples collected by the parents from a representative area of the home carpets was analysed by ELISA as described previously [20].

### Definitions

The diagnosis of the lifetime prevalence of an atopic disorder in parents was made on the basis of the respective questionnaire item, in children on the basis of physical examinations and of case histories reported by the parents [18]. An infant was considered sensitized when the IgE concentration against at least one of the test allergens was equal to or greater than 0.35 kU/L ( $\geq$  CAP class 1) at 3 or more of 5 follow-up visits. A mite and cat allergen concentration above 2000 ng/g dust was defined as high.

The educational and the occupational level of the parent contributing the highest share to the family income (in 90% of families the father) and the income level itself were each assigned to four classes and then summarized, resulting in scores ranging from 3 to 12. The sum was divided by four resulting in three SES classes: low, middle or high [21].

### Statistics

Odds ratios and (approximate) 95% Cornfield's confidence intervals were computed as a measure of association between the outcome variables and SES. Associations in two-dimensional contingency tables were assessed by Pearson's chi-square tests. Logistic regression models with backward stepwise elimination procedures were used to evaluate the contribution of several variables influential to the outcome. Statistical computations were performed with SPSS for Windows, Version 6.1, logistic regression analyses with STATA5.

## Results

Of the parents in our cohort 19.1% had low, 46.3% middle and 34.5% high socioeconomic status. In univariate analysis, the risks for hay fever and asthma, and for the objective marker aeroallergen sensitization were significantly higher in parents of high SES compared to low SES, Table 1. But no association between SES and AD could be found.

Atopy promoting life-style factors such as smoking in pregnancy, smoking at home (reported 18 months after birth), pet ownership of the family, and even a high mite and cat allergen concentration in carpet dust were significantly more common with low SES. But prolonged breast-feeding for over 6 months was significantly commoner with middle and high SES. Therefore, the risk of any of these atopy promoting life-style factors to be present in the family was lower with high and middle SES, Table 2.

In children of these families neither early AD nor any of the other atopic phenotypes at any age interval had a relationship to SES, except for AD from 3 to 6 years, Table 3.

For the age range 3 to 6 years, logistic regression models were fitted to evaluate whether SES, and related variables (gender, number of older siblings, maternal age) were significant risk factors for the development of atopic phenotypes, when other potential risk factors were included in the

regression analysis, i.e. environmental factors such as study centre, mite, cat allergen and tobacco smoke exposure, prolonged breast-feeding, genetic factors such as the specific family history (no atopy, other atopy than outcome phenotype, same phenotype), and mediating factors such as sensitization to food allergens and aeroallergens. Most of these risk factors could be removed from the models because their influence was negligible or substituted by others. The most interesting factors were left in the final models: Only the identical phenotype of the parents and sensitization against either food or aeroallergens remained significant risk factors for asthma, rhinitis, and AD from 3 to 6 years, Table 4. Additionally, for AD beyond infancy SES remained a significant risk factor, while a long breast-feeding duration was of borderline significance.

## Discussion

Education in parents appears to act as an indicator of socioeconomic circumstances in early life of their children, while income seems to be a stronger determinant for diseases in adulthood [22]. Because our aim was to analyse the influence of socioeconomic status in children and their parents, a social index was constructed from education of the parent contributing the highest share to the family income and

**Table 1.** Lifetime prevalence of atopic disorders in parents according to socioeconomic status (SES)

| Disorder                   | Prevalence percentage ( <i>n</i> ) | Odds ratio (95% confidence interval) |                             |                             |
|----------------------------|------------------------------------|--------------------------------------|-----------------------------|-----------------------------|
|                            |                                    | low SES                              | middle SES                  | high SES                    |
| Aeroallergen sensitization | 42.5 (643/1512)                    | 1                                    | <b>1.494 (1.124; 1.987)</b> | <b>1.755 (1.299; 2.371)</b> |
| Hay fever                  | 25.4 (576/2266)                    | 1                                    | <b>1.581 (1.183; 2.113)</b> | <b>2.364 (1.762; 3.172)</b> |
| Asthma                     | 7.4 (169/2292)                     | 1                                    | 1.286 (0.800; 2.069)        | <b>1.738 (1.078; 2.801)</b> |
| AD                         | 5.2 (116/2249)                     | 1                                    | 0.899 (0.536; 1.508)        | 1.170 (0.694; 1.972)        |

**Table 2.** Prevalence of atopy relevant life-style factors in parents and socio-economic status (SES). Mite dust, cat dust = concentration of mite and cat allergen in carpet dust of the home

| Life-style factors                  | Prevalence percentage ( <i>n</i> ) | Odds ratio (95% confidence interval) |                             |                             |
|-------------------------------------|------------------------------------|--------------------------------------|-----------------------------|-----------------------------|
|                                     |                                    | low SES                              | middle SES                  | high SES                    |
| Mother smoking in pregnancy         | 25.1 (272/1083)                    | 1                                    | <b>0.675 (0.479; 0.952)</b> | <b>0.345 (0.232; 0.513)</b> |
| Smoking in home at 18 months        | 45.3 (445/983)                     | 1                                    | <b>0.690 (0.477; 0.998)</b> | <b>0.310 (0.209; 0.457)</b> |
| Pet ownership at 3 month            | 31.8 (330/1038)                    | 1                                    | <b>0.715 (0.507; 1.008)</b> | <b>0.374 (0.256; 0.547)</b> |
| Mite dust > 2000 ng/g at 6/18 month | 21.3 (129/654)                     | 1                                    | 0.623 (0.372; 1.044)        | <b>0.424 (0.245; 0.736)</b> |
| Cat dust > 2000 ng/g at 6/18 month  | 11.7 (73/626)                      | 1                                    | 0.911 (0.473; 1.754)        | <b>0.381 (0.176; 0.817)</b> |
| Breastfeeding > 26 weeks            | 25.9 (299/1153)                    | 1                                    | <b>2.523 (1.579; 4.030)</b> | <b>4.672 (2.919; 7.479)</b> |

**Table 3.** Prevalence of atopic diseases and symptoms in children and socio-economic status (= SES)

| Disease<br>(y = years)     | Prevalence percentage (n) | OR (95% CI) |                      |                             |
|----------------------------|---------------------------|-------------|----------------------|-----------------------------|
|                            |                           | low SES     | middle SES           | high SES                    |
| Sensitization 1 or 2 y     | 31.5 (143/454)            | 1           | 0.997 (0.579; 1.720) | 0.870 (0.485; 1.563)        |
| Sensitization 3 or 5 y     | 43.7 (173/396)            | 1           | 0.893 (0.519; 1.539) | 0.832 (0.470; 1.472)        |
| Rhinoconj. up to 2 y       | 5.4 (48/895)              | 1           | 1.480 (0.552; 3.972) | 1.661 (0.611; 4.521)        |
| Rhinoconj. 3–6 y           | 21.6 (178/825)            | 1           | 1.183 (0.719; 1.945) | 1.068 (0.640; 1.792)        |
| Recurr. wheezing up to 2 y | 16.2 (145/895)            | 1           | 1.004 (0.600; 1.680) | 0.840 (0.489; 1.444)        |
| Recurr. wheezing 3–6 y     | 20.7 (171/825)            | 1           | 0.815 (0.502; 1.322) | 0.902 (0.549; 1.483)        |
| AD up to 2 y               | 20.9 (187/895)            | 1           | 1.973 (0.862; 2.439) | 1.605 (0.944; 2.730)        |
| AD 3–6 y                   | 25.0 (206/825)            | 1           | 1.574 (0.924; 2.682) | <b>2.423 (1.418; 4.138)</b> |

Odds ratios and 95% confidence intervals (OR, 95% CI). Rhinoconj. = rhinoconjunctivitis apart from colds.

income level [21]. The educational level of both parents was significantly correlated in this study ( $P < 0.0001$ ).

A higher prevalence of aeroallergen sensitization, hay fever and asthma was found in parents of higher SES. But a higher SES was not a risk factor for AD in these adults. The results agree with some other studies describing a

generally larger gap in the prevalence of respiratory diseases than of AD in school children as well as in adults between wealthy compared to less affluent societies [3,23]. The reason for this discrepancy could be, that the history of the lifetime prevalence of atopic diseases is taken from self-administered questionnaires, in our case from the parents. A

**Table 4.** Odds ratios (OR) and 95% confidence intervals (95% CI) for AD, asthma, and rhinoconjunctivitis in children aged 3–6 years by several risk factors, adjusted for each other and also adjusted for study centre

| Disease          | Risk factor                       | Odds ratio   | 95%CI               |
|------------------|-----------------------------------|--------------|---------------------|
| Rhinoconj. 3–6 y | Parental atopy, except rhinoconj. | <b>2.015</b> | <b>1.032; 3.935</b> |
|                  | Parental rhinoconj.               | <b>2.467</b> | <b>1.630; 3.733</b> |
|                  | SES high                          | 0.846        | 0.456; 1.570        |
|                  | Smoking in home at 18 months      | 1.052        | 0.715; 1.548        |
|                  | Breast feeding > 6 months         | 1.136        | 0.759; 1.700        |
|                  | Aeroallergen sensitization        | <b>3.457</b> | <b>2.150; 5.561</b> |
|                  | Food sensitization                | <b>1.608</b> | <b>1.005; 2.573</b> |
|                  | Female                            | 0.712        | 0.487; 1.040        |
|                  | Parental atopy, except asthma     | 1.504        | 0.971; 2.331        |
|                  | Parental asthma                   | <b>3.006</b> | <b>1.723; 5.247</b> |
| Asthma 3–6 y     | SES high                          | 0.780        | 0.427; 1.424        |
|                  | Smoking in home at 18 months      | 1.318        | 0.884; 1.966        |
|                  | Breast feeding > 6 months         | 0.890        | 0.580; 1.368        |
|                  | Aeroallergen sensitization        | <b>3.127</b> | <b>1.917; 5.101</b> |
|                  | Food sensitization                | <b>1.959</b> | <b>1.215; 3.160</b> |
|                  | Female                            | 0.737        | 0.499; 1.087        |
|                  | Parental atopy, except AD         | 1.068        | 0.719; 1.586        |
|                  | Parental AD                       | <b>2.108</b> | <b>1.175; 3.781</b> |
|                  | SES high                          | <b>2.310</b> | <b>1.241; 4.298</b> |
|                  | Smoking in home at 18 months      | 1.207        | 0.829; 1.757        |
| AD 3–6 y         | Breast feeding > 6 months         | 1.410        | 0.959; 2.072        |
|                  | Aeroallergen sensitization        | <b>1.646</b> | <b>1.005; 2.694</b> |
|                  | Food sensitization                | <b>2.631</b> | <b>1.664; 4.161</b> |
|                  | Female                            | 1.175        | 0.816; 1.691        |

SES = socioeconomic status, Rhinoconj. = rhinoconjunctivitis apart from colds.

reporting bias towards lower prevalence rates for early manifestations of atopic disorders, e.g. for AD, can be expected, and this is supported by an analysis of our data reported elsewhere [24]. This opinion is also corroborated by the findings in two cross-sectional studies on young school children in former East and in West Germany, respectively, where trained physicians examined the skin conditions: A higher prevalence rate of AD with higher social class was observed in both studies [25,26].

But it could also be, that different risk factors or different time windows in early childhood were responsible for the SES disparity in the prevalence of AD compared to respiratory atopies in parents, e.g. similar intrauterine exposures for AD, but different rates of virus infections in infancy for respiratory allergies [12,27,28].

Because parents of this study did not receive structured preventive or therapeutical advice, any interventional effects were unintended. Early differences in atopy relevant life-style factors between socio-economic classes were probably a consequence of better knowledge and of an experienced atopic history in parents of high compared to low SES. This may have favourably influenced the frequency of atopic disorders in their child. Consequently, we did not find an association between SES and atopic diseases or specific sensitization in early childhood, except for AD from 3 to 6 years.

High SES, a prolonged breastfeeding duration and AD in childhood were associated in many other studies [5–7]. An explanation could be, that the effect of early food avoidance programs on the prevalence of AD does not last for more than 2 years [29]. While AD in infants from high SES with a high atopy risk can be avoided by breastfeeding, introduction of allergenic foods in later infancy promotes the development of AD in former breastfed infants. Prolonged breastfeeding as well as a high SES may even be indicators for a high atopy risk. Another explanation could be that prolonged breastfeeding (typical for infants from high SES) promotes AD in later childhood because it compromises the development of tolerance or of a permanent allergen specific intestinal immune response of the Th1 type at a critical developmental period [12].

Since parental life-style counteracted most other environmental risks associated with higher SES, in the multiple logistic regression model, the parental phenotypes and sensitization were left as the most important risks for the development of atopic diseases in children. A high SES remained an additional risk factor only for AD from 3 to 6 years.

Favourable life-style habits of parents with higher SES could not influence the genetic risk: The parental atopic phenotypes as well as specific sensitizations of the child persisted as major risk factors for atopic disorders in these children.

## Acknowledgements

MAS, the Multicentre Allergy Study was supported by a grant from the German Ministry of Research, Education and Technology, no. 01EE9406.

## References

- 1 Nicolai T, Bellach B, von Mutius E, Thefeld W, Hoffmeister H. Increased prevalence of sensitization against aeroallergens in adults in West compared to East Germany. *Clin Exp Allergy* 1997; 27:886–92.
- 2 ISAAC Steering Committee. Worldwide variation in prevalence of asthma, allergic rhinoconjunctivitis, and atopic eczema. *ISAAC Lancet* 1998; 351:1225–32.
- 3 Gergen PJ, Turkeltaub PC, Kovar MG. The prevalence of allergic skin test reactivity to eight common aeroallergens in the US population: results from the second National Health and Nutrition Examination Survey. *J Allergy Clin Immunol* 1987; 80:669–79.
- 4 Strachan DP. Hay fever, hygiene, and household size. *Br Med J* 1989; 299:1259–60.
- 5 Taylor B, Wardsworth J, Golding J, Butler J. Breast feeding, eczema, asthma, and hay fever. *J Epidemiol Community Health* 1983; 37:95–9.
- 6 Williams HC, Strachan DP, Hay PJ. Childhood eczema: disease of the advantaged? *Br Med J* 1994; 308:1132–5.
- 7 Butland BK, Strachan DP, Lewis S, Bynner J, Butler N, Britton J. Investigation into the increase in hay fever and eczema at age 16 observed between the 1958 and 1970 British birth cohorts. *Brit Med J* 1997; 315:717–21.
- 8 Sibbald B, Rink E. Labelling of rhinitis and hay fever by doctors. *Thorax* 1991; 46:378–81.
- 9 Strachan DP, Harkins L, Johnston IDA, Anderson R. Childhood antecedents of allergic sensitization in young British adults. *J Allergy Clin Immunol* 1997; 99:6–12.
- 10 Von Mutius E, Martinez FD, Fritzsche C, Nicolai T, Reitmeir P, Thiemann HH. Skin test reactivity and number of siblings. *Br Med J* 1994; 308:692–5.
- 11 Matricardi PM, Franzinelli F, Franco A, Caprio G, Murru F, Cioffi D, Ferrigno L, Palermo A, Ciccarelli N, Rosmini F. Sibship size, birth order, and atopy in 11, 371 Italian young men. *J Allergy Clin Immunol* 1998; 101:439–444.
- 12 Cook OCM, Moffat MF. Asthma: an epidemic in the absence of infection. *Science* 1997; 275:41–2.
- 13 Duff AL, Pomeranz ES, Gelber LE, Price GW, Farris H, Hayden HG, Platts-Mills TAE, Heymann PW. Risk factors for acute wheezing in infants and children: viruses, passive smoke and IgE antibodies to inhalant allergens. *Pediatrics* 1993; 92:535–40.
- 14 Burr M, Miskelly FG, Butland B, Merrett G. Environmental factors and symptoms in infants at high risk of allergy. *J Epidemiol Comm Health* 1989; 43:125–32.
- 15 Martinez FD, Wright AL, Taussig LM, Holberg CJ, Halonen M, Morgan WJ, the Group Health Medical Associates. Asthma and wheezing in the first six years of life. *New Engl J Med* 1995; 332:133–8.
- 16 Lewis S, Richards D, Bynner J, Butler N, Britton J. Prospective

- study of risk factors for early and persistent wheezing in childhood. *Eur Respir J* 1995; 8:349–56.
- 17 Halfon N, Newacheck PW. Childhood asthma and poverty: differential impacts and utilization of health services. *Pediatrics* 1993; 91:56–61.
- 18 Bergmann RL, Edenharter G, Bergmann KE, Forster J, Bauer CP, Wahn V, Zepp F, Wahn U. Atopic Dermatitis in Early Infancy is a Predictor of Respiratory Atopy at 5 Years. *Clin Exper Allergy* 1998; 28:228–32.
- 19 Bergmann RL, Forster J, Schulz J, Bergmann KE, Bauer CP, Wahn U. Atopic family history. Validation of instruments in a multicenter cohort study. *Pediatr Allergy Immunol* 1993; 4:130–5.
- 20 Lau S, Falkenhorst G, Weber A, Werthmann I, Lind P, Buettner-Goetz P, Wahn U. High mite allergen exposure increases the risk of sensitization in atopic children and young adults. *J Allergy Clin Immunol* 1989; 84:718–25.
- 21 Winkler J. Die Messung Des Sozialen Status Mit Hilfe Eines Index in Den Gesundheitssurveys der DHP (Scaling social status in the German National Health Surveys). In W. Ahrens, B. Bellach, KH. Jökel. eds. *Messung soziodemographischer Merkmale in der Epidemiologie*. RKI-Schriften, MMV Munic, 1998: 69–74.
- 22 Smith GD. Socioeconomic factors and determinants of mortality. *Letter JAMA* 1988; 280:1744–5.
- 23 Von Mutius E, Weiland S, Fritsch C, Duhme H, Keil U. Increasing prevalence of hay fever and atopy among children in Leipzig, East Germany. *Lancet* 1998; 351:862–6.
- 24 Kulig M, Bergmann R, Bergmann K, Edenharter G, Wahn U and the MAS-group. Does allergy in parents depend on allergy in their children? Recall bias in parental questionnaires on atopic diseases. *J Allergy Clin Immunol* 2000; 105:274–8.
- 25 Heinrich J, Popescu M, Wyst M, Goldstein IF, Wichmann HE. Atopy in children and parental social class. *Am J Public Health* 1998; 88:1319–24.
- 26 Buser K, Werner S, Volk P. Krankheit und soziale Lage-Sonderfall Neurodermitis. *Gesundheitswesen* 1998; 60: 311–6.
- 27 Szepefalusi Z, Nentwich I, Gerstmayr M, Jost E, Todoran L, Gratzl R, Herkner K, Urbanek R. Prenatal allergen contact with milk proteins. *Clin Exper Allergy* 1997; 27:28–35.
- 28 Withers NJ, Low L, Holgate ST, Clough JB. The natural history of respiratory symptoms in a cohort of adolescents. *Am J Resp Crit Care Med* 1998; 158:352–7.
- 29 Zeiger RS, Heller S. The development and prediction of atopy in high risk children: Follow-up at age seven years in a prospective randomized study of combined maternal and infant food allergen avoidance. *J Allergy Clin Immunol* 1995; 95:1179–9030.